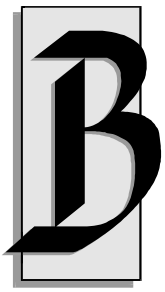

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Sharing and Reducing the Financial Risks of Future "Mega-Catastrophes"

Working Paper

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Executive Summary

The devastating 2005 hurricane season—especially the three large hurricanes that struck the Gulf Coast and Florida (Katrina, Rita and Wilma)—has graphically demonstrated how dangerous nature can be. The huge storms also should serve as a wake-up call to remind us that, even if the United States manages to escape another terrorist attack, it is virtually certain that at some point there *will* be one or more natural catastrophes with similar or even greater catastrophic impacts: earthquakes in the West (California, Seattle) or Midwest (along the Mew Madrid fault) and perhaps multiple Category 4 or 5 hurricanes (like Katrina or worse) in the Gulf or on the East Coast, including a possible direct hit as far north as New York.

So far, policy makers and the media have concentrated on how to rebuild the areas damaged by the storms so that they can withstand Category 4/5 hurricanes in the future. This is appropriate and necessary. But little or no attention is being given to how to reduce and pay for the potential costs of future "mega-catastrophes" of the kinds just witnessed, singly (Katrina) or in combination, during the 2005 hurricane season. This must change. Had more thought been given to this subject and suitable action taken prior to this summer, the losses (human and economic) would not have been as great, especially in the case of Katrina, and the process of recovering from losses would have been less chaotic.

Among the many impacts of Katrina, one is especially relevant to this essay. In effect, by the nature and magnitude of its response, the federal government post-Katrina resolved a debate that simmered among policy makers and academic scholars during the 1990s: whether the federal government should provide some kind of backstop insurance to the private market for large disasters. Clearly, the answer to that question after Katrina, is "yes", although the post-Katrina "backstop" is informal and ad hoc. This essay will argue that this ad hoc or *de facto* insurance system is also *inefficient* because it provides inadequate incentives for loss prevention and *unfair* because those most at risk from future catastrophes do not bear a disproportionate amount of the costs to repair and rebuild, as they should.

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Going forward, the critical question now is whether the federal government can do better with a more formal reinsurance system for mega-catastrophes, which also has incentives for better loss prevention or mitigation. And just as clearly, this essay argues that the answer to *this* question also is "yes." The pre-funding mechanism suggested here is a formal federal reinsurance program, open to both private and state-sponsored primary insurers and reinsurers. The recommended program would be administered by a quasi-independent arm of the Treasury Department (analogous to the regulator for federally-charted banks, the Comptroller of the Currency). The mechanics of the program are modeled, in part, on the federal terrorism risk reinsurance program established in 2002, but also differ in key respects. Unlike terrorism insurance, this program could be primarily pre-funded, supplemented if necessary by non-subsidized post-event assessments. Premiums would reflect actuarial risk, including incentives for states and localities to adopt and enforce cost-effective building codes and land use rules.

If the federal government is to be the last "layer" of financial protection, then protection below the threshold for federal government involvement should be a combination of protection provided by the state and private sectors. In particular, it is fully appropriate that individuals and businesses bear some limited amount of the "first dollar" losses, through insurance policy deductibles; and that private and state-sponsored insurers and reinsurers be next in line, up to some ceiling.

A layered system of financial responsibility coupled with better preparedness and cost-effective mitigation incentives for mega-catastrophes makes sense on many levels:

- It protects the federal fisc, and reserves federal responsibility for only the large losses that the other actors cannot absorb without significant distortions in the private market. In the process, a pre-funded system is more equitable for current and future generations of taxpayers, who are liable for more of the mega-catastrophic costs under the current, post-event system of disaster aid than they would be under the pre-funded federal reinsurance program recommended here.

- A layered system provides appropriate incentives for the parties in each "layer" to take loss mitigation measures to minimize their own exposures to financial loss in a cost-effective manner. Faced with the actuarially justified annual costs for living or working in exposed areas, some individuals and businesses may choose to locate elsewhere. Others may decide to accept the inevitable risks associated with particular locations, but to improve construction of their houses and businesses to minimize losses. State and local governments may decide to improve public infrastructure—including construction of higher levees in flood-prone areas—to minimize financial exposures. Given the financial exposure of all governments involved, it is fully appropriate, and indeed *necessary*, that they also be able to impose and enforce cost-effective mitigation requirements to reduce losses from future mega-catastrophes.

- It is fully appropriate that the federal government reinsure against mega-catastrophe risks. Because of its borrowing capacity and its ability to print money,

the federal government does not have the "timing risk"—or the risk that losses will occur too soon before premiums are collected to fully fund them—that private insurers, reinsurers, state-sponsored catastrophe insurers and reinsurers inevitably face. By providing backstop insurance for the largest losses, the federal government would dramatically shrink this timing risk, and thus improve the ability of private and state-sponsored insurers and reinsurers to charge actuarially appropriate premiums that are not burdened with additional and costly risk loadings to help absorb timing risk. Furthermore, actuarially appropriate premiums would promote cost-effective mitigation and thus reduce the social and economic costs of future natural catastrophes.

To anticipate objections to the comprehensive financial and risk mitigation system recommended here, it is useful to briefly provide answers to some of them at the outset. More detailed responses are provided in the body of the report.

Isn't federal insurance a "bailout for the private insurance industry"? No, to the contrary, a federal insurance program is designed to *protect the federal government—and more specifically taxpayers, current and future—from the costs of future mega-catastrophes.* History has demonstrated time after time that when disaster strikes—especially mega-disasters—governments will not sit idly by and let injured people suffer. Government has provided disaster aid and always will do so in the future. The issue for policy makers is *how to pay for that aid*: wait until the disasters happen, and then borrow or print money, to impose higher taxes or cut back other programs; or to *pre-fund, to the extent possible, the costs of future mega-catastrophes by charging insurance premiums (through their private insurers) to those most exposed to those losses?* This essay argues that the last option is superior to each of the others.

It is useful to think of the proposed system for pre-funding mega-catastrophe risks as the equivalent of the federal government charging a "user fee" for those living in disaster prone areas, just as it now charges individuals to enter a federal park, or airline travelers for airplane security.

Doesn't the private insurance industry have at least $400 billion in capital to cover future catastrophe losses? Why can't it cover these costs by itself?

The $400 billion in surplus held by property-casualty (p-c) insurers doing business in the United States represents capital available to pay for *all types of losses that may occur in variety of geographic areas*. The losses include those related to exposures from commercial enterprises, homeowners, and automobile owners due to a wide variety of natural and man-made events, as well as losses suffered by individuals, professionals and commercial enterprises arising out of tort (or liability) lawsuits. The majority of this surplus is not available for the natural disaster losses suffered by property owners, for a variety of reasons:

(1) none of the surplus held by p-c insurers that do not write property insurance is available;

(2) multi-line companies generally establish separate affiliates to write property insurance so that capital of their non-property companies (auto, medical malpractice, workers compensation) is not available to cover property losses; and

(3) even property insurers often establish separate affiliates for high risk states so that the capital of their operations elsewhere is not available to cover losses in those states.

In short, aggregate or industry-wide measures of capital are irrelevant when calculating the ability of the "industry" to absorb future mega-CAT losses.

The same logic holds for global reinsurers, who in 2005, held an estimated $350 billion in capital. This aggregate figure includes premiums collected by some insurers doing business entirely abroad, as well as reinsurers that are also active in the primary insurance market. In addition, reinsurers specialize in different types of risk so that the aggregate capital is not available to cover risks that may be unique to specific reinsurers.

If private insurers don't have the money, why can't the securities markets absorb the risk of losses from mega-catastrophes?

In fact, there is a nascent market in catastrophe-linked securities, which provide higher yields to investors willing to assume the risk of non-payment of interest and principal in the event of a "covered" event. But the catastrophe-linked securities market has never developed in the way and to the extent its advocates claimed it would. In retrospect, one reason is that insurance regulators have not permitted insurers that issue the securities to count them as the equivalent of reinsurance. But even if this policy is changed—as suggested here—policy makers should not count on the catastrophe-linked securities market developing quickly. The securities will not significantly help insurers unless the events that release the issuers from having to repay them are more closely tied to the losses suffered by specific insurers. But the greater the risk that repayment of principal will be cancelled, the higher will be the interest rate premium that investors will demand before they purchase the securities. Because it is far from clear to what extent insurers will want to issue these securities at these higher interest rates, a federal reinsurance program is still be appropriate (at least for some significant period), even if the regulatory (and financial) accounting treatment of catastrophe securities is changed.

Why can't states simply require insurers to offer catastrophe coverage at an affordable price? However hard they may try, regulators and policy makers cannot change the laws of nature. In order to operate in a safe and sound manner—as they must if they are to honor claims of their policyholders—insurers must base premiums on expected future losses. Those expectations, in turn, are based on historical experience, and knowledge gained through scientific studies and computer modeling, adjusted for projected changes in economic exposure (driven by population growth, construction and acquisition of property). If expected losses on this basis rise, then so must premiums.

Regulators that force insurers to charge less than actuarially justified premiums for catastrophe coverage sooner or later will drive insurers from the market; indeed their investors (whether shareholders or policyholders, in the case of mutual companies) will demand that result. When insurance capacity declines, coverage inevitably gets rationed, leaving some customers uninsured. States that counter that result by forcing insurers to subsidize "residual markets" for customers who cannot obtain insurance in the "voluntary market" diminish incentives for insurers to write any insurance in the voluntary market, or to do so with sizeable deductibles that limit insurer exposures.

Subsidized insurance rates—in both the voluntary and residual markets—ultimately lead to higher disaster costs in the long run, because they discourage individuals and the governments that represent them from undertaking cost-effective steps to reduce losses from catastrophes. As a result, subsidies raise the social costs of disaster.

Why can't states with significant catastrophe exposure address the issue themselves through state created programs? State sponsored plans have helped to remedy dysfunctional markets to a certain extent in Florida and California. Yet, state plans, just like private insurers and reinsurers, do not have sufficient resources to pay for mega-catastrophes. Indeed, those that currently exist cap their exposures, in large part because such events confront state plans, like their private sector counterparts, with substantial timing risk.

The more cost-effective approach to holding down insurance rates *and* promoting better mitigation is for the only entity that can absorb the "timing risk" that mega-catastrophes entail—the federal government—to provide reinsurance to the private and state-sponsored insurance markets, with premiums tied to risk exposure, which in turn reflects the mitigation efforts adopted and enforced by state and local governments. Such an approach is also fairer to taxpayers generally, and to those who live in locations not subject to extraordinarily high risks of mega-catastrophes.

Introduction

The 2005 hurricane season will long be remembered as the costliest season yet for natural catastrophes in the United States. Though the official damage estimates will not be known for some time, it is already clear at this writing (November 2005) that the total damage to public and private property from just the three largest hurricanes—Katrina, Rita and Wilma—will run into the hundreds of billions of dollars.

The hurricanes left more than death, serious personal injury and devastating financial distress in their wake. It has already been widely commented that Katrina in particular exposed the deep poverty in New Orleans that had long existed but that had not been widely appreciated by Americans across the country. Katrina also made clear that all levels of government were not prepared for a storm of that magnitude, and that government decisions before, during and after the hurricane magnified rather than reduced the damage and loss of life and injury. Officials quickly absorbed some of the

lessons from the failures of Katrina in responding to Rita and Wilma, and no doubt will be taking advantage of the respite from this year's hurricane season to develop better disaster recovery and mitigation plans for future hurricane seasons and major earthquakes.

But there is more planning to be done. The 2005 hurricanes should prompt all policy makers and citizens to address two fundamental questions relating to how society should prepare for and pay for future natural disasters, especially "mega-catastrophes," or those natural disasters that alone, or in combination with other similar events during the same calendar year, impose extraordinary costs to society:

1. How can the government best prevent or mitigate losses from future natural mega-catastrophes in a cost-effective manner?

2. Given that catastrophes, and especially mega-catastrophes, will continue to occur, who should pay for the damage, how and when?

Until this hurricane season, the answers to these questions seemed fairly well settled. States and local governments were primarily responsible for loss prevention and mitigation, through land use rules and building code requirements. The federal government also played some role in loss prevention, paying in selective cases for some or all of the infrastructure costs (such as levees) and, in some limited instances, relocation expenses aimed at minimizing flooding in particular. Insurers also have given individuals and firms some incentives to mitigate losses, either by providing lower premiums on structures more resistant to catastrophic damage (on homes bolted to their foundations to reduce earthquake losses, or residences on stilts in low lying areas to reduce exposure to floods), or by denying coverage in some high-risk areas altogether, giving individuals and firms stronger incentives to avoid building or living in those locations.

All of the above parties also have shared in the financial responsibility for catastrophes. Insurers cover the losses of those who insure privately. Most states offer residual market plans, statewide or in catastrophe prone areas, for residents unable to purchase insurance in the voluntary market. Two states, California and Florida, offer catastrophe plans, one directly to homeowners (California for earthquakes) and the other to insurers (Florida for hurricanes). The federal government requires individuals living in designated flood-prone areas to purchase flood insurance (up to a limit), and at least theoretically has charged premiums that are actuarially fair (though the program provides subsidies for those purchasing flood insurance for properties acquired before they were identified as being in a flood plain). The federal government also traditionally has provided disaster relief aid after the fact to victims, including individuals, firms and local and state governments.

Following Andrew and Northridge in the early 1990s, this mixed private/public system of mitigation and financial responsibility attracted some attention. The system has had its critics through the years—some have questioned its cost-effectiveness and/or its fairness. After a decade of neglect, it is once again attracting serious interest among

policy makers. The 2005 hurricane season, Katrina in particular, exposed serious weaknesses in both parts of the system that, in this author's view, cry out for immediate attention.

First, Katrina dramatically demonstrated the cost of not investing in adequate prevention. Had the levee between Lake Pontchartrain and the northern border of New Orleans been built to withstand a Category 4 hurricane, as many had urged for years, New Orleans might have been spared serious flooding, many lives could have been saved, and perhaps $100 billion or more in damage averted. But the New Orleans debacle is only one example of the weaknesses in the current system of loss prevention and mitigation. Despite the clear threat of hurricanes and flooding, millions of Americans continue to move each year to coastal areas along the East Coast and the Gulf, increasing the potential cost of future hurricanes. The same is true in California, where the danger is from earthquakes. It would be one thing if all those moving were made fully financially responsible for the risks to which they voluntarily assuming, but this is not currently the case.

Second, the overwhelming federal disaster relief effort after Katrina has made clear, if there was ever any doubt, that the federal government is the *de facto* "insurer" of last resort for mega catastrophes. Federal aid for Katrina alone is likely to exceed $100 billion, and an undetermined but certainly large amount will be provided to cover losses that could have been insured against but weren't. The federal government's response is understandable and, as argued below also defensible, given the magnitude of the Katrina catastrophe, and sets a precedent that surely will be followed in future catastrophes of this sort.

What is less defensible, however, is the way in which the post-Katrina compensation is being financed: solely by issuing debt, thus imposing the ultimate cost on future taxpayers throughout the United States. While this method of financing may be appropriate for terrorist attacks—since an assault on any part of the country is an assault on all of us and thus the cost for responding and rebuilding should be borne widely—it is fundamentally unfair to ask citizens who are not exposed to unusually large catastrophe losses to cross-subsidize those who voluntarily choose to live and work in areas where they are so exposed. It is also inefficient to ask taxpayers generally to pay for catastrophe losses *ex post* rather than to have, or indeed require, those who are most exposed to those losses pay for them *ex ante* through actuarially appropriate insurance premiums. If individuals and firms do not bear the costs associated with living and working in certain locations, then too many will subject themselves to catastrophic risks, and those who do decide to locate in such areas will have insufficient incentives to take steps that can reduce the damage from catastrophic events when they occur.

We can do better. With the right policies, we can do more to minimize future losses from the natural catastrophes—and especially mega-catastrophes—that inevitably will continue to occur. And we can distribute the costs of those events more efficiently and fairly than is the case now. All that is required is to formalize the current *de facto*

federal disaster insurance program. This essay concludes with a plan for doing precisely that.

Mega-Catastrophes: Defining The Problem

It is necessary to begin by defining the nature or the scope of the problem for which a solution is later outlined—namely, by defining a "mega catastrophe." Up to this point, the term admittedly has no standard definition and the one offered here admittedly will be arbitrary. But events like Katrina have a certain "you know it when you see it" character that helps to create a new vocabulary.

As used here, a "mega-catastrophe" is single natural disaster, or a combination of lesser disasters in a 12 month period (the standard insurance contract period being a year), whose consequences for insurers are so large that *going forward* they become "uninsurable", or the potential or actual subjects of exclusions in standard policies. Put another way, mega-catastrophes are events or total losses from a series of defined events over a given time period that cause insurance markets to "fail" in some significant respect.

Insurance is built on several principles, which must be present for insurance companies to operate successfully over the long term. As is now discussed, mega-catastrophes do not satisfy all of these principles.[2]

The Law of Large Numbers

The events at issue must be subject to the "law of large numbers." In statistical terms, this means that the average from a sample of events gets closer to the mean of the population from which the events "are drawn" as the sample size increases. In less technical terms, it means that for insurers to have some idea of what the risk of a given event is, they must have some idea of how *probable* it is, as well as the range of its possible *severity*.

Typically, the actuaries who work for insurers gain knowledge about these parameters from past episodes; they can supplement that knowledge with other information, such as geological (earthquakes) or meteorological (hurricanes and wind storms) studies, combined with computer models that "predict" amounts of damage given certain events. Fortunately, there is no such historical experience or scientific knowledge associated with terrorist attacks, especially those on the scale of 9/11 or potentially larger, which fall into the category of man-made mega-catastrophes. This was a reason that the Bush Administration did not seek to set reinsurance premiums under the federal terrorism reinsurance program, and instead agreed to legislation requiring "recoupment", but only up to a point, from primary commercial insurers (and ultimately policyholders) after the fact. Nonetheless, terrorism risks are not the focus of this essay, though lessons from the

[2] This typology draws on David Cummins, 2005. "Should the Government Provide Insurance for Catastrophes?", paper presented at a conference at the Federal Reserve Bank of St. Louis, October 21-22, 2005.

federal government's terrorism program are relevant to the design of an analogous program for large natural disasters and are featured below.

With enough historical data, it is possible to provide rough estimates of the likelihood that mega-catastrophes, as the term is used here, will occur. But the qualifier "rough" cannot be over-emphasized. Whether the 2004-05 hurricane seasons prove to be abnormal, normal, or precursors of even worse seasons will not be known for some time. Thus, actuarial estimates of both the frequency and severity of mega-catastrophe events and seasons are inherently subject to considerable uncertainty. Insurers bearing these risks compensate for that uncertainty by charging higher risk "loads", or multiples of annual expected losses.

Independence and Timing Risk

Insurance requires that the insured events be "independent"; that is, the probability that one insured will suffer a loss should be independent of the probability that others suffer losses from the same event. Independence is required so that insurers can diversify their sources of risk and thus not be exposed to a single event or series of events that deplete the insurer's capital or surplus (the amount contributed by investors to absorb losses beyond the loss reserves that insurers establish for likely claims).

Natural or man-made disasters (terrorism) typically violate the independence condition, since many insureds in a given geographic area or areas are damaged at the same time when these occur. Nonetheless, insurers may still be willing to accept and insure such risks if, at the same time, they can purchase *reinsurance* from reinsurers, or issue *securities* to investors, who can pool disaster risks from different parts of the world so that the events themselves (rather than the individuals affected by them) are independent of one another. Still, as discussed below, the price for such reinsurance, given the growing costs and possibly increasing frequency of mega-catastrophes like Katrina, may be so high that primary insurers are unable (due to demand conditions or to rate regulation) to pass them on to policyholders. In that event, some of those exposed to catastrophe risk either would forego coverage, or insurers will not offer it.

Absence of Adverse Selection

The events insured must not be subject to excessive "adverse selection," so that the insurance is purchased *only* by those exposed to high risks of claims. This condition is related to the independence requirement. If adverse selection exists then insurers cannot diversify their risks across a wide population, and thus premiums may be insufficient to cover claims when the events occur.

There is some element of adverse selection for hurricane and earthquake risks, since many individuals choose to live in high risk locations and purchase the insurance. But fortunately the regions affected by these potential or actual disasters are large enough so that in any given year, or even over a number of years, the risks tend to be widely dispersed. This is not as true for those who live in floodplains, which tend to repeatedly

experience flooding. Because these individuals and firms can pinpoint their exposures, flood insurance is especially prone to adverse selection, which is the major reason that private insurers for a long time were unwilling to voluntarily extend coverage. The federal government stepped in with its own flood insurance program in 1968, and even made the purchase of flood insurance mandatory for borrowers from federally chartered institutions, in order to protect both them and their lenders from flood damage.[3]

Summary

In short, a natural disaster or series of disasters in a given time period (for this purpose a year) is a "mega-catastrophe" when private insurance markets fail in some significant respect. Failure in this particular market is of broader social concern because when *individuals or firms exposed to those risks do not find the cost of private insurance to be worth its purchase, then they are wittingly or unwittingly imposing at least some of the costs of future disasters on the federal government, which experience has shown (especially in the wake of Katrina), will provide significant aid (albeit not total compensation) after the fact.* Although the provision of aid is certainly understandable, it is essential for policy makers to recognize that without appropriate counter-balancing policies, such aid will lead to even more substantial federal costs when future disasters inevitably visit the same areas. Indeed, as discussed further below, the post-hurricane aid in Florida and the Gulf region already is leading to a rebuilding boom. Unless those who rebuild or purchase property in storm-damaged areas are confronted *in advance* with the true costs of such reconstruction, location and construction decisions will be distorted, leaving the federal government—and future taxpayers—to pick up a larger tab when the next hurricane strikes than it would if those who put themselves in nature's way pay for that added risk through insurance.

To be sure, the federal government's disaster relief programs cover all types of disasters, and it would be a mistake for policy makers to treat all of them as "mega-catastrophes." If they did, federal aid could crowd out the private insurance market altogether, including insurance for lesser losses which the private market can readily and cost-effectively absorb. But mega-catastrophes are qualitatively and quantitatively different, in that the losses from the event and amounts of post-event federal assistance are potentially so great that insurers and the investors who back them in the future will seek either to exclude coverage for them altogether or to require such high premiums or deductibles in future policies that, going forward, large numbers of consumers will choose to forego coverage altogether. This is an undesirable outcome not only because it leaves the federal government with some additional disaster aid in the future, but also because it can discourage these individuals and firms from undertaking cost-effective loss prevention measures (or supporting state and local officials who adopt and enforce more effective building codes and land use rules).

[3] For a thorough description of the flood insurance program, especially in the wake of Katrina, see Center on Federal Financial Institutions (COFFI), 2005. "Federal Flood Insurance After Katrina" (October 16, 2005), at www.coffi.org.

Admittedly, the line between ordinary disasters and mega-catastrophes is an arbitrary one. I would simply assert that, given the extraordinary level of federal assistance that eventually will be provided in the wake of Katrina, that event or similar episodes (such as those illustrated in Table 2 discussed in the following section) would qualify as mega-catastrophes for purposes of this essay. State policies indirectly also suggest that events of lesser magnitude would qualify as well. As discussed further below, Florida's catastrophe reinsurance fund has a current annual cap of $15 billion, suggesting that insured losses above that level are deemed too expensive even for a state-sponsored plan (that ultimately is backed by Florida's homeowners). The California Earthquake Authority, meanwhile, has current claims paying capacity of approximately $7 billion, implying that insured losses above that level are too large for that system to bear.

The Rising Risks and Costs of Mega-Catastrophes

Disaster losses are not unusual for property-casualty (p-c) insurers; that is why standard homeowners', automobile, and business property policies cover damages from windstorms and hurricanes (earthquakes are treated specially, and are discussed below). As long as the costs of these events are manageable and capable of being reinsured (by reinsurers or the markets), they are insurable by primary p-c carriers.

There is a disturbing trend, however, toward more frequent and more severe catastrophic events. Table 1 lists the 12 most costly insured catastrophes in the United States, all expressed in 2005 dollars. What jumps out from the list is that *eight of the 12 most costly episodes have occurred within the past four years, and three of them (Katrina, Rita and Wilma) have occurred in just the last calendar year*.

In the case of hurricanes, it is only natural to wonder whether 2005 (or 2004, for that matter) was an unusual year, or whether, for any number of reasons, recent experience is only a harbinger of future hurricanes to come. If data alone are any guide—and historical data are the principal basis for actuarial estimates of future expected losses—then clearly recent trends do suggest a higher probability and severity of future such events. There is also scientific support for this view. Many scholars believe that the entire North Atlantic region is now in the midst of a several decade long upsurge in intense hurricane activity.[4] The damaging impact of this upsurge in storms could be aggravated, if as some scholars also believe, global warming may be leading to greater numbers of and more intense hurricanes.[5]

Even if hurricanes turn out not to be more frequent in the future, continuing population shifts and additional construction nonetheless are likely to increase their severity, measured in damage costs, though various mitigation measures—such as better building codes that are effectively enforced and restrictions on building in especially high

[4] Bjorn Lomborg, "Gulf Coast Consensus," *The Wall Street Journal*, October 11, 2005, p. A16.

[5] See, e.g. Emanuel, Kerry, *Nature*, August 4, 2005; Webster, P.J., G.J. Holland, J.A. Curry and H.R. Chang, *Science*, Vol. 309, Issue 5742, September 16, 2005, pp. 1844-46.

risk areas (close to beaches)—may slow the rate of increase. Thus, according to a recent demographic analysis by *USA Today*, population in coastal areas along the Atlantic and the Gulf Coast has increased by 2 million (to over 44 million) since 2000, despite the increased frequency and intensity of hurricane activity. The same report indicates that about 1,000 people arrive as new residents in these areas every day.[6] Individuals also continue to move into areas subject to earthquake risk.

Not only are people moving to risk-prone areas, but property development there is booming. Although the hurricanes in Florida and the Gulf are inducing some long-time residents to think about never returning, property developers are anticipating that many new residents can be attracted to coastal areas after they are rebuilt. In the words of a recent *Wall Street Journal* article, "the spate of storms is fueling an extraordinary level of new economic development …" One of the contributing factors cited is post-disaster infrastructure redevelopment funded by the federal government. As one Florida planning department administrator put it: "This is federally funded urban renewal for resort areas."[7]

Indeed, looking back, the nation is "lucky" that some of the most naturally devastating events of the past occurred when far fewer people were exposed: the Galveston hurricane of 1900, the California earthquake of 1906, the Great Hurricane of 1938 (the "Long Island Express'), or the New Madrid earthquakes of 1812-14. Had those events occurred in recent years, the property damage and lives lost could have been as catastrophic as Katrina, or worse.

Looking ahead, as more people move into and construction proceeds in areas of the country prone to natural catastrophes, the costs of such events—whether or not they become more frequent—will only grow. Table 2 illustrates the possible property losses for several potential natural catastrophes, assuming they would soon occur (the costs would be higher in the future, because of population growth and additional construction). While most of the property losses for the hurricanes would be insured, the fraction of insured losses would be much less in the case of earthquakes, where the take up is much lower, as discussed shortly (though, still even for earthquakes, the insured costs could still be substantial). Worst-case losses could be twice as high as those shown in the table. The key point from Table 2: the unprecedented insured losses from Katrina easily could be surpassed by any number of possible natural catastrophes in the future.

To be sure, the probability that any of the events listed in Table 2 would occur in any single year is low. But it is likely that at least one of them will occur at some point in the future.

Where Will New Private Capital To Support Catastrophe Policies Come From?

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[6] Haya El Nasser and Paul Overberg, "Despite Storms, Coasts Fill Up," *USA Today*, October 21-23, 2005, p. A1.

[7] Evan Perez, "Battered By Storms, Florida Panhandle Sees Property Boom," *The Wall Street Journal*, October 25, 2005, p. A1.

In theory, private insurers, perhaps working with reinsurers and the capital markets, could pay for substantially higher losses associated with single mega-catastrophes, or combinations of somewhat less severe events in a single year with similar cumulative losses, by charging substantially higher premiums than in the past and/or by requiring significant deductibles on the policies they do offer.

But, in practice, they may not be able or unwilling to do so. Not only do mega-catastrophes pose substantial financial risks, *but their timing is highly uncertain,* thus giving rise to what is known in the industry as *timing risk.* This means that insurers who assume the risk of covering losses from catastrophes confront the possibility of having to pay potentially huge claims to policyholders (or to primary insurers, in the case of reinsurers) well before they are able to collect sufficient premiums to cover their costs. The problems of charging actuarially sound rates are aggravated by state imposed rate regulation.

Accordingly, reinsurance may be so expensive that primary insurers choose not to purchase it, knowing that they cannot pass on the costs to their policyholders without running a significant risk that many will choose not to insure at all. This failure to purchase coverage is a problem even when insurance premiums are artificially suppressed. For example, as discussed shortly, relatively few eligible California homeowners have purchased earthquake insurance from the California Earthquake Authority (CEA), a specialized entity established after the Northridge earthquake in 1994 to provide earthquake coverage.

The nature and magnitude of catastrophe risks, as well as unique "timing risk" that mega-catastrophes in particular pose for insurers, can be illustrated by the following rough hypothetical calculations.

Assume for illustrative purposes that all of the property-casualty coverage for residents of coastal regions along the Gulf and the Eastern seaboard –or those most exposed to hurricanes—is written by carriers who operate in all those states, so that the catastrophe risk is spread among insurers in proportion to their premiums. The 44 million people who now live in these areas comprise approximately 15 percent of the nation's population, and thus would account for roughly 15 percent of the $69 billion in premiums (in 2004) for homeowners and commercial property damage (see Table 3), or about $10 billion.[8] In contrast, hurricane losses over just the last four years, 2002-05 (2001 is excluded because of the extraordinary losses associated with the 9/11 terrorist attacks, or man-made events), as calculated from the data shown in Table 4, have averaged over $20 billion annually.

Again, for illustrative purposes only, suppose that the $20 billion in annual catastrophe losses is likely going forward, and that roughly $3 billion of the $10 billion in premiums collected is designated for natural disaster losses. These assumptions imply that premiums would then need to increase by $17 billion ($20 billion minus $3 billion),

[8] This is most likely an underestimate because coastal areas carry higher risk and thus premiums there should be somewhat above average.

or to nearly triple, in order to cover future expected losses. But even this calculation is conservative, since it ignores timing risk in that it assumes no extraordinary years—like 2005—when insured costs could be 2-3 times higher than the assumed $20 billion annual average. In that event, insurers could only pay claims during an extraordinary claims year if they had accumulated surplus from profits earned in prior years. And even then, that surplus would have been accumulated to pay to off unexpected claims due to non-catastrophic events. Depleting surplus for catastrophes—before sufficient premiums have been collected to fund them—thus would leave insurers without capital to cover these extraordinary claims. Furthermore, having depleted accumulated surplus for one extraordinary year could force insurers to shrink their customer base to fit their small capital base, while leaving them in future years exposed to potential ruin if hurricane costs in any single year again reached multiples of the assumed $20 billion in annual costs.

The ability of private insurers at least to partially address the timing risks is impaired by the federal income tax laws, which do not permit insurers to deduct annual contributions or set-asides to reserve accounts for future catastrophe losses.[9] State catastrophe funds, discussed shortly, are not subject to this constraint. They can accumulate catastrophe reserves that are not subject to federal (or state) income tax and thus can build reserves for catastrophes at a faster pace than their private sector counterparts, yet even these state funds must find ways to address the timing risks posed by mega-catastrophes.

National Underwriting Doesn't Solve The Timing Risk Problem

One might think that insurers in the illustrative hypothetical just outlined could avoid financial ruin by operating on a nationwide basis—namely, by collecting premiums from policyholders around the country to help defray the claims costs associated with policyholders in areas exposed to high hurricane risk. But this not only would be unfair to policyholders elsewhere in the country, but competition will not sustain such cross-subsidies on an ongoing basis. If national underwriters deliberately set premiums in such a way that lower-risk policyholders were charged more to keep rates down for policyholders in higher-risk areas, eventually regional carriers operating only in lower-risk areas would take market share—and ultimately perhaps most, if not all, of the customers in those areas—away from the national carriers. Indeed, this is a central reason why many national underwriters establish separate state-chartered insurers, so that at least legally, insurer surplus in low risk states cannot be used to pay off claims in higher risk states (National insurers nonetheless may allow such transfers on an episodic basis for marketing reasons, but that is a matter of choice, not a legal requirement).

Private Reinsurance Doesn't Solve The Timing Risk Problem

While there is little doubt that reinsurers will be able to handle claims even from the extraordinary 2005 hurricane season, the critical question is how reinsurers will

[9] However, insurers do have the ability to carry losses back and forward, once the losses have occurred, but not to take deductions for contributions toward a reserve in advance.

respond *going forward.* Here, reinsurers must operate from the same set of actuarial principles that govern primary insurance. If there is a region of the world that consistently faces higher risk of damage than elsewhere—and the coastal regions of the United States confronting hurricane risk presumptively fit this pattern—then even reinsurers that now operate on a global scale (and thus are able spread losses across insurers from many regions) eventually will be forced by competition to charge much higher rates to primary insurers who are exposed to those risks. Insurers call this additional amount the "risk load"—or the multiple by which reinsurers multiply expected annual losses to protect themselves both against timing risk and uncertainties involved in estimating the expected losses themselves. Pre-Katrina, a risk load of 5 to 7 times annual expected loss (or 400 percent to 600 percent) was typical.[10] In the wake of Katrina, demand for reinsurance by primary insurers is virtually certain to grow, but reinsurers are likely to meet the demand only by offering coverage at premiums with substantial and possibly even higher risk loads (multiplied by higher expected losses, given the enormous losses of the 2004-05 hurricane seasons).

Reinsurance premiums (including risk loads) are a cost of doing business for primary insurers, who will then attempt to pass them to policyholders, *if state regulators permit.* If they do not, then primary insurers will not purchase the reinsurance, and indeed will have incentives to avoid putting themselves at risk in the first place, by withdrawing from offering policies to customers in high-risk markets entirely, or by significantly cutting back their coverage (through higher deductibles and, if regulators will let them, by denying catastrophe coverage altogether). *In effect, the inability of primary insurers to price coverage with high-risk loads that reflect timing and uncertainty risk in the catastrophe risk market lead to market failure.*

It is widely recognized that reinsurance is a heavily cyclical industry, in which premiums rise and fall with some regularity. In so-called "soft markets," there is plenty of capital and competition among reinsurers (and insurers) to deploy it through underwriting coverage, which drives down premiums and eventually profits. "Hard markets" typically arise after profits indeed have fallen or after a period of unusually high losses, which slows down or halts capital inflows into the industry, which in turn drives premiums back up. Eventually profits increase, attracting some (but perhaps not all) capital back to the industry and the cycle resumes.

The extraordinary losses during the 2004 and 2005 hurricane season will not repeal the reinsurance cycle. Rather, to the extent reinsurers believe that these losses portend a permanent upward shift in either or both the frequency and severity of such storms, they will commit capital to reinsurance only at higher premium level than otherwise would have been the case, and even then in smaller amounts. In effect, the cycle will continue, but from a higher base.[11] Indeed, as primary insurers seek to replace capital lost from catastrophes in 2004-05, this additional demand alone will place upward

[10] Congressional Budget Office, 2002. *Federal Reinsurance for Disasters* (Washington, D.C.), p. 24.
[11] Indeed, this has occurred in past insurance cycles, and indeed up to 2001, the price for catastrophe reinsurance while cyclical nonetheless has trended up. See Congressional Budget Office, 2002. *Federal Reinsurance for Disasters* (Washington, D.C.: Congressional Budget Office, September), p. 13.

pressure on reinsurance premiums, as will the reevaluation by ratings agencies and regulators of the amounts of capital required by primary insurers to maintain their secure claims-paying ratings.

Indeed, the recent intense scrutiny by investors and regulators of the reinsurance industry is likely to reinforce this outcome. One result of the increased attention is likely to be greater transparency among reinsurers, and specifically disclosure of the extent to which they are covering different types of risk. Reinsurers backing insurers exposed to hurricane areas in the United States, in particular, are likely to face pressure to justify their rates for reinsurance in these areas. And with more advanced risk-pricing tools, they are likely to be in a better position to respond to such pressure. As a result, if primary insurers truly are exposed to greater claims losses, then enhanced disclosure and greater use of risk-based pricing should help ensure that reinsurance premiums will be priced higher to reflect that risk.[12]

Financial Markets Have Not Solved Nor Are Likely To Solve The Timing Risk Problem

In the 1990s, there was a flurry of optimism that the global financial markets—which are much deeper and more liquid even than global reinsurance markets—would come to the rescue and pick up catastrophe risks that primary insurers and reinsurers would or could not bear.

The initial catastrophe-related securities in fact were derivative instruments—futures contracts and options, launched by the Chicago Board of Trade. Under these instruments, payoffs were contingent on catastrophe losses hitting certain levels: on a national basis, for five regions and for three states (California, Florida and Texas). Trading volumes were low for these instruments and they were later withdrawn. Professor David Cummins of the Wharton School of Finance at the University of Pennsylvania speculates that this happened because the insurers who would have issued the contracts could not be certain that the counterparties who bought them actually would pay off in the event a catastrophic event required them to. In addition, the contracts could not protect the insurers against "basis risk," which arises from the fact that the loss indices were too broad to have covered more geographic-specific risks (and thus the contracts would not have "paid off" for the insurers in the event of the catastrophe they were most worried about, such as a Florida hurricane).[13]

Subsequently, catastrophe-linked bonds, or CAT bonds, have been developed and sold to investors by insurers, or through related entities (typically a single purpose reinsurer, or SPR). These securities pay investors a premium interest rate to accept the risk of non-payment (cancellation of the principal) in the event of a catastrophic event,

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[12] The pressures for greater transparency by reinsurers, coupled with their development and use of better risk-based pricing, are described in Standard & Poors, *Global Reinsurance Highlights*¸ 2005 edition, pp. 11-12. Significantly, this document was published before Katrina, and thus its forecast for falling reinsurance premiums no longer seems relevant.

[13] Cummins, 2005, p. 18.

which can either be defined in physical terms (earthquake or hurricane of a certain magnitude), or by industry-wide or insurer-specific losses. At various times, proponents of these bonds have argued that investors should be interested in them not only because of their high yields, but because the performance of the bonds is likely to be uncorrelated with that of the equities, thus offering opportunities for large institutional investors to the bonds as means of diversifying their portfolios.

Key to the structure of the CAT bonds is the definition of the event that can trigger the release of the issuer's obligation to repay them. This definition, in turn, involves an inevitable tradeoff between moral hazard (the increased incentive to take or at least not to avoid it, knowing one has the insurance) and basis risk. Securities that are tied to the losses of specific insurance (indemnity CAT bonds) are the functional equivalent of reinsurance and thus have no basis risk; but can entail moral hazard (less incentive to be prudent in paying claims) if the issuer does not bear at least some portion of any loss once the triggering event has occurred (as is true for federal terrorism insurance). At the other extreme, securities that are tied to industry-wide losses or to specific named events (such as an earthquake above a certain magnitude) reduce or eliminate moral hazard, but entail some basis risk since insurers cannot know whether the indices or the event will relieve them of the obligation to repay the bond, and thus act like reinsurance. For this reason, state insurance regulators have not yet approved non-indemnity based CAT as reinsurance for regulatory accounting purposes, which reduces the interest of insurers in issuing them (because regulators instead presumably require insurers to back their premiums with greater capital instead).

Professor Cummins argues that this regulatory treatment has limited the interest of insurers in issuing CAT bonds, and thus has limited the size of the market. Through March 2005, for example, he notes that the approximately 120 CAT bond issues to date have raised about $10 billion in funds for insurers, of which only about $2 billion were then outstanding—both small amounts compared to the $350 billion in capital in the global reinsurance industry and roughly $400 billion in capital in the U.S. property-casualty industry (figures which are discussed in more detail below).[14] Indeed, insurer interest in issuing the bonds seems to be on the decline. New CAT bond issues totaled $1.14 billion in 2004, down from $1.73 billion in 2003.[15]

What accounts for the disappointing volume of catastrophe-linked bonds? Cummins suggests that insurers view CAT bonds to be too expensive compared to reinsurance (or self-insurance). Although spreads over LIBOR (the short-term London Interbank Borrowing Rate, a conventional interest rate yardstick) on CAT bonds have come down from the more than 6 percentage point (or 600 basis points) in the late 1990s, they are still hovering at 4.5 percentage points (450 basis points). Cummins suggests that the interest rate premium is still high because investors may continue to be unfamiliar with the bonds and worried about the reliability of catastrophe loss prediction models; the trading of such bonds is infrequent; and a belief by some investors that "big catastrophes"

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[14] Ibid., p. 20.
[15] Aaron Pressman and Chester Dawson, "An Unbreached Financial Levee," *Business Week*, September 26, 2005, p. 97.

in fact would be correlated with the stock market and thus the bonds in fact do not represent good diversification vehicles (if the "Big One" hits, the bonds will cancel and the market will go down, both at the same time). Nonetheless, Cummins draws comfort from the fact that large institutional investors still seem to be interested in the securities, as reflected in their declining spreads. He also argues that insurer interest in issuing them, meanwhile, would be furthered if regulators were to permit insurers to count non-indemnity CAT bonds as reinsurance for regulatory purposes.[16]

Clearly, insurers would be more interested in issuing non-indemnity CAT bonds if regulators changed their accounting policy, which I recommend and discuss below. But it is far from clear that even if this recommendation were adopted, investors would be interested in buying sufficient volumes of these securities that the financial markets would thus "solve" the timing risk and catastrophe insurability problems that primary insurers and reinsurers now confront. For this reason, it would be a mistake in my view for policy makers to assume otherwise. And the reason, ironically, is underscored by what happened in CAT bond market after Katrina.

One would think that if there were ever an event that would trigger the principal cancellation provisions of non-indemnity CAT bonds, it would have been a mega-hurricane like Katrina. But this turns out not to have been the case. The wind speeds were not high enough nor the barometric pressure low enough to trigger the event language written into some of the bonds, while the aggregate insured losses may not be high enough to trigger the principal cancellation provision in others.[17] While this is clearly good news for investors in CAT bonds, it cannot give much comfort to insurance company issuers, who are still obligated to repay the bonds. In effect, then, the bonds that are outstanding in the market therefore have not functioned like reinsurance and thus have done nothing to cushion the financial blow suffered by the insurers that issued them.

If insurers are going to look to CAT bonds to be the functional equivalent of reinsurance in the future—and, indeed if state regulators are to be more inclined to treat the bonds this way, especially in light of the failure of Katrina to trigger non-payment of the bonds—the trigger points and possibly other features of those bonds will have to be changed, to reduce "basis risk" and thus increase the likelihood that insurers will be able to cancel their repayment obligations. But any moves in this direction, which would enhance insurer interest in selling the bonds, also would discourage potential investors from buying them, whether or not the bonds count as reinsurance for regulatory accounting purposes.[18]

Summary

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[16] Cummins, 2005, pp. 21-22.

[17] Pressman and Dawson.

[18] The discussion of CAT bonds in this section applies to so-called "pre-event" bonds, or bonds sold before some event has occurred. The limitations with these securities do not apply to "post-event" bonds, which state sponsored plans may issue to cover the costs of catastrophes once they have occurred. These bonds are backed by assessments on policyholders and thus have a secure revenue stream to finance debt service.

In sum, there is market failure for mega-catastrophes: the losses and timing risks they entail are so large that market-determined premiums are not charged. Even if premiums are artificially suppressed, many of those at risk may be unwilling or unable to purchase coverage. Katrina demonstrates what happens then: the federal government becomes the *de facto* insurer of last resort, and not only for political reasons. Only the federal government, which essentially has unlimited borrowing capacity, has the ability to withstand early claims payment without going bankrupt in the meantime. As discussed below, a central policy issue going forward is whether the *de facto* nature of the current federal insurance backstop (provided in the form of disaster aid) should be formalized, and if so, how.

Existing Insurer Capital Is Insufficient And Irrelevant Going Forward

If insurers cannot pay for future mega-catastrophe costs out of future premiums, it may be tempting to conclude that they can cover these costs out of the $400 billion in capital or "surplus" that the property-casualty insurance as a whole has accumulated over time through retained earnings and invested capital. Or if this capital is not sufficient, then the primary insurers can call on another $350 billion in capital held by global reinsurers.

Even if these figures accurately represented sums available to pay catastrophe claims, it is important to recognize at the outset that *any surplus accumulated in the past* cannot be looked to as *a sustained source of funding for future catastrophic events* for several fundamental reasons.

First, the surplus amounts, by definition, are inherently *backward looking*. They afford insurers and reinsurers a cushion against financial failure in the event of a sharp spike in claims costs and/or losses in their investment portfolios, but once these untoward events have occurred and existing surplus has been depleted, there will be no surplus available for future and continuing losses caused by mega-catastrophes or to support the more routine insurance needs of a growing population—unless premiums are significantly increased and in fact paid by policyholders so that future surplus can be generated. If it were otherwise, then insurance would not be a sustainable business. And if premiums cannot sustain future losses, or consumers are unwilling or unable to pay actuarially appropriate premiums, *then the insurance market will have failed.* In less technical terms, insurer surplus is like having a finite number of cookies in a cookie jar. Take a lot of the cookies away—because of one or more large catastrophic events—and there are no more cookies available in the event they are needed for *continuing, future catastrophes.*

Second, the aggregate surplus figures for the entire p-c industry, or for the global reinsurance industry, cover many different lines of insurance, only a few of which are even relevant to natural catastrophes. Although surplus is not reported by line of insurance, it should be somewhat proportional to premiums written by line, data for which are available. As illustrated in Table 3, premiums for homeowner's and commercial multi-peril policies—those most affected by natural catastrophes—accounted

for just $78 billion of the $436 billion in total p-c premiums collected in 2004, or roughly 18% of the industry figure. Applying that percentage to the $402 billion in surplus available industry-wide in 2004 yields a total of $72 billion in surplus—a rough estimate of the capital backing property coverage.

Of course, the "true" figure varies somewhat from this number because some insurers write coverage across multiple lines, which would tend to raise the total surplus available. On the other hand, even multi-line insurers, as well as their "mono-line" counterparts (those engaged in underwriting only one type of risk), often establish separately capitalized insurers for the sale of property insurance in different states, which lowers the amount of surplus available to satisfy claims on a nationwide basis. Many insurers also establish single-line companies for high risk states which further lowers the amount of capital available to pay claims arising in those states. It is conceivable that these various effects cancel each other out, but whether or not they do, the central point is that far less than half, or probably less than a quarter, of the surplus among all primary p-c insurers is realistically available to pay catastrophe claims.

The aggregate figures for reinsurer surplus also cover many different lines of primary insurance—predominantly for high-frequency risks—as well as different regions of the world.[19] In particular, the figures include reinsurers that extend coverage only outside the United States, and clearly this capital is not available to pay for U.S.-based catastrophe claims. There is also a certain amount of "double counting" of reinsurer capital in this $350 billion figure. This arises because the aggregate reinsurer figures count the surplus of a number of major reinsurers that also are active in the primary insurance market (so the figures for reinsurance partially back the primary market as well).

Third, the aggregate surplus figures for the entire primary and reinsurance industries, as well as within any particular line of coverage, by definition sum the surplus of *individual insurers*, which are exposed in different ways to different types of risk. In other words, the capital backstopping various catastrophe risks is not evenly distributed. And at the end of the day, it is the surplus that is held by these individual insurers that matters, since the capital of one insurer cannot be called upon to pay claims of other insurers (except in a very limited way, through state guaranty funds, under which all surviving insurers in a state can be assessed annually to pay claims of insurers that fail in that state).

State Catastrophe Plans Alone Cannot Be Counted Upon To Solve The Catastrophe Problem

Two states—Florida and California—have recognized the difficulties entailed in underwriting catastrophe risks, and have responded by organizing state funds to provide insurance or reinsurance for this purpose. Although the two funds differ in structure, both of them still involve the private insurance industry in some way—so that the private sector is still exposed to loss. At the same time, neither of these states funds cover *all*

[19] Cummins, 2005, p. 13.

catastrophe risks, especially the losses of very large, or mega-catastrophes, and thus leave consumers and businesses at risk for potentially significant losses. The Florida catastrophe reinsurance fund (the "Florida CAT" fund) caps coverage at $15 billion, while the California Earthquake Authority currently can cover only about $7 billion in earthquake damages. In addition, as will now be discussed, catastrophes in years like 2005 are putting enormous strains on some state plans, and threaten their long-term viability.

Nonetheless, the California and Florida catastrophe plans each have brought much greater stability to insurance markets in those states than would have occurred otherwise. But neither plan was devised to deal with the mega-catastrophes that possibly lie ahead.

Florida

Florida responded with various initiatives following the devastation of Hurricane Andrew, which up to that time was the most expensive hurricane in the United States. Insurers not surprisingly wanted to withdraw from covering property in all or part of the state, or if they stayed, to raise premiums. The Florida legislature thwarted these efforts by requiring insurers previously doing business in the state to renew most preexisting policies and limiting rate increases.[20] Rate regulation, however, discouraged insurers from extending new policies. Florida responded to this problem by creating a "residual market facility", the Florida Residential Property and Casualty Joint Underwriting Association (the "JUA"), which acted as an insurer of last resort. A similar residual market facility was created just for wind damage along the coast, The Florida Windstorm Underwriting Association. Insurers doing business in the state were financially responsible for both associations, and were subject to assessments if premiums set by these facilities—which deliberately were set below market—proved to be insufficient to cover claims. In 2002, the two facilities were merged into a single entity, Citizens Property Insurance Corporation, which not only has the ability to assess insurers for premium shortfalls, but to issue tax-exempt bonds if necessary. Citizens currently accounts for about 1/3 of the Florida property insurance market.

Meanwhile, Florida also required insurers offering property-casualty coverage in the voluntary market to purchase reinsurance from Florida Hurricane Catastrophe Fund (FHCF or the "Florida CAT fund"), at premiums based on their exposure to hurricane losses in the state. The coverage only kicks in once damages in any year exceed $4.5 billion (2005 retention), but is capped at approximately $15 billion in annual losses. Although the FHCF is not backed by the state, it is operated as a state agency, exempt from both state and federal income taxes, and as noted earlier, can accumulate reserves much more rapidly than can any private insurer. The Florida CAT fund also has the ability to impose additional assessments on all policyholders of primary insurers exposed to hurricane losses in the event of shortfalls and to issue bonds, if needed to provide short-term financing (with debt service covered by post-event assessments).

[20] In any single year, insurers permitted to drop no more than 10 percent of their residential policies in a country and no more than 5 percent statewide. CBO, 2002, p. 14.

California

The California Earthquake Authority (CEA) was established in 1996 by the California legislature, following the Northridge earthquake of 1994. The CEA essentially supplements the private insurance market and its insurance is distributed through private primary insurers, who must offer earthquake coverage as part of their homeowners' policies, either their own or the insurance provided by the CEA. Strictly speaking, the CEA is not as clearly a residual market facility, as is found in Florida and other states. Instead, the CEA has a mandate to offer earthquake coverage at actuarially-based premiums, though the Authority does allow for some subsidies for those in especially high-risk areas.

As it has turned out, the CEA has not crowded out private insurers, who underwrite about half of the earthquake coverage directly on their own account (not through the CEA) in the state, though the voluntary coverage is concentrated in lower risk areas.[21] CEA policies tend to cover higher-risk areas. Still, however, only a small portion of eligible California residents purchase *any* type of earthquake coverage: just 13.6 percent in 2003, down from 33 percent in 1996, the CEA's first year.[22]

One explanation for the low take-up rate is that unlike the wind peril policies in Florida, mortgage lenders do not require homeowners to purchase earthquake coverage. Another key factor is the high deductibles, at both the initial and upper layers of damage. Thus, the standard CEA policy deductible is 15% of any loss. As property values and replacement costs have risen over time, so has the absolute dollar amount of this deductible, reducing the value of the coverage. The CEA's contract also contains various exclusions and tight caps on contents and living expenses.[23] In addition, the CEA's claims paying ability is limited; at year-end 2004, it stood at $6.9 billion.[24] By comparison, the insured component of a large future California earthquake (such as one depicted in Table 2), could easily exceed $15 billion (applying the 14% take-up rate to the estimate of total loss). This means that homeowners who purchase coverage from the CEA are on their own for earthquakes causing damage above $7 billion.

Limitation of State Funds

Meanwhile, nature has already tested the state residual markets facilities in Florida and the Gulf, and all are now under significant pressure. After the 2004 hurricane season, Citizens Property Insurance Corp. in Florida stood in deficit of over $500 million, prompting the company to assess private insurers in the state during this past summer, which insurers have now passed to their policyholders. With Katrina and Wilma having hit the state this season, future premium hikes are in store for next year. Louisiana's

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[21] California Department of Insurance, 2005. "2004 California P&C Market Share Report: Line of Business, Earthquake,"
[22] Cummins, 2005, p. 25.
[23] CBO, 2002, p. 7.
[24] Price-Waterhouse-Coopers, 2005. *California Earthquake Authority: Report on Audits of Financial Statements for the Years Ended December 31, 2004 and 2003*.

facility, the Louisiana Citizens Property Insurance Corp. after Katrina and Rita is likely to have a deficit of roughly $600 million, in a far smaller state. Indeed, half of the 32 state organized risk pools for disasters are now in deficit.[25]

An inherent problem with state-run residual funds is that they are subject to strong political pressures to charge premiums that are actuarially too low.[26] This has been a chronic problem in Florida, even prior to the 2004-05 hurricane seasons.[27] Following the 2004 season, one actuarial analysis suggested that premiums in Florida should be 80% higher or more in higher risk-areas.[28] Citizens, and other state funds like it, can issue bonds to cover revenue shortfalls in the short run, but eventually they must charge higher premiums to policyholders, if the interest on those bonds is to be paid. Clearly, if the 2005 hurricane season is a harbinger of things to come, and if premiums are not raised to their actuarially-justified levels, then Citizens (and other similarly situated state funds) will not be financially viable over the long run.

This is not just a short or even long run financial problem. Holding down rates below actuarial levels reduces incentives for loss mitigation, which raises disaster costs over the long run. Furthermore, laws requiring insurers to remain in state, subject to government imposed rate limitations drives more homeowners to the residual plans, which face deeper financial problems as catastrophe losses climb higher. That leaves the federal government as the true insurer of last resort, which Katrina demonstrated it to be (although the government did not collect any "premium" up front to help pay for this risk).

De Facto Federal Insurance for Mega-Catastrophes Is Inefficient and Unfair

In fact, through the federal government's various disaster aid programs, the government has always been somewhat of an insurer of last resort for disasters, large and small. The large ones are the focus of this essay. Table 5 lists the top ten natural disasters in which the federal government has provided aid in the past, ranked by cost.

The federal government provides aid to individuals and households to cover some losses; and to states and local governments and non-profit organizations for recovery and repair. Individual and household aid is available from a number of agencies and programs, listed in Table 6. Much of this aid goes to individuals who do not have insurance or whose insurance does not cover all of their losses. In the case of Katrina, the aid for repair and reconstruction of entire cities and towns will be extraordinary, likely well in excess of $100 billion. This amount also almost certainly exceeds what the federal government would have had to contribute if effective incentives for loss mitigation had been in place prior to this awful event.

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[25] Chad Terhune and Theo Francis, "Hurricanes Squeeze State Insurers of Last Resort," *The Wall Street Journal*, October 24, 2005, p. A1.
[26] The federal reinsurance program below, which backstops state funds, has a mechanism to ensure that the funds charge actuarially sound rates.
[27] Collins Center for Public Policy, 1995. *Final Report of the Academic Task Force on Hurricane Catastrophe Insurance* (Tallahassee, Florida).
[28] Ibid.

Disaster aid is a humanitarian response by government to events that cannot be controlled. But like all aid, it must be financed. Aid that comes in the form of insurance claims is paid for out of accumulated premiums. Aid that is provided by government ultimately must come from taxpayers, either immediately through higher taxes or cuts in other programs (which rarely occurs) or eventually to service the debt that is issued to finance it (the typical response, especially when the federal government is already in deficit, as has been the case through the past two severe hurricane seasons).

Federal Disaster Aid As De Facto Insurance

Government aid, after the fact, effectively is *de facto* insurance. That is, by consistently providing disaster aid, the federal government has an implicit contract with American citizens that in the event of a natural disaster—small or large—the federal government will compensate some uninsured losses suffered by individuals, businesses, and governments. In this connection, it should be noted that individuals and business directly benefit from federally funded reconstruction of public infrastructure, which is typically more modern than what previously existed. In addition, when the government provides funds for prevention or mitigation—for example, by building higher levees after hurricane-related floods (as is expected in the case of New Orleans) or by financing the construction of seawalls and the restoration of local beaches—then individuals and businesses who return or who are attracted to the area later also benefit.

The critical policy question, then, is not *whether* the federal government is going to provide *de facto* insurance in the form of disaster relief, but how such insurance *is going to be financed*: specifically, by taxing current or future generations of Americans, regardless of where they live and thus regardless of the exposure they may have to disasters, or by charging insurance premiums *in advance* (or "ex ante") to those who are most exposed.

There is a good case for asking all Americans to pay for costs associated with terrorist attacks, which technically may be attacks on particularly visible targets (such as the World Trade Center and the Pentagon), but in reality are attacks *on the nation.* We do not tax people or businesses by their residence or location to pay for national defense. By the same token, it would be inappropriate to require residents of the areas surrounding the location of the attacks to bear the sole burden for reconstruction and compensation.

Formal Federal Catastrophe Programs

Nonetheless, after 9/11, federal policy makers responded by creating a more formal federal program for terrorism insurance, as some other countries have done (see Appendix A for details). Until that event, private insurers had provided terrorism coverage only implicitly. After it, insurers sought and obtained specific exclusions in most states where they did business. Concerned that the unavailability of terrorism coverage would thwart future construction of some properties, Congress responded by enacting the Terrorism Risk Insurance Act of 2002, which expires on December 31, 2005

(unless it is renewed, a topic of Congressional consideration at this writing). TRIA has several key features:

- TRIA is a *reinsurance* program, covering only *commercial* losses of primary insurers. *TRIA does not apply to life, health, or personal property lines of insurance.*[29] TIRA also acknowledges that not all terrorist acts (notably nuclear or radiation-related events) are covered by its insurance contracts.

- TRIA requires private insurers to bear the "first loss" of terrorist attacks, events which must be declared as such by the Secretary of the Treasury,[30] up to 15 percent of insurers premiums earned on TRIA-eligible lines offered the previous year.

- TRIA's covers 90 percent of losses above the deductible, up to $100 billion (though as a practical political matter, any losses above that the federal government is likely also to bear, largely if not fully, certainly after Katrina's precedent).

- TRIA requires the government to recoup in future years, through annual premium surcharges on insurers of up to 3 percent on commercial policyholders, a limited amount of the federal payouts ($15 billion minus the sum of insurer deductibles and co-payments).

The Administration did not request nor did Congress require the federal government to collect premiums for terrorism reinsurance *in advance.* This is due to the inability to assign an actuarial risk of terrorism, and thus to set an appropriate premium. In addition, TRIA deliberately contains an element of federal subsidy, since the recoupment of federal payouts is expressly limited. Thus, theoretically, taxpayers and insureds effectively split the costs of future terrorist attacks under the TRIA program in particular.

In practice, however, because large fractions of commercial enterprises do not purchase insurance with terrorism coverage, a recent RAND analysis of possible future terrorist attacks indicates that taxpayers are not likely to bear any costs, at least formally. Indeed, if current take-up rates had applied at the time of the 9/11 attacks, taxpayers would have not borne any of the costs had TRIA been in place.[31] As a result, there are likely to be substantial uninsured losses in the event of a future attack, and therefore political pressures for federal disaster aid after the fact. So taxpayers remain at risk,

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[29] At this writing, discussions are under way in connection with the reauthorization of TRIA to extend it to group life insurance. Proponents argue that this coverage is similar to workmen's compensation.

[30] Specifically, the Act defines a terrorist act as a violent act or an act that is dangerous to human life, property or infrastructure, causing damage in excess of $5 million, and to have "been committed by an individual or individuals acting on behalf of any foreign person or foreign interest, as part of an effort to coerce the civilian population of the United States or to influence the policy ….. of the United States Government by coercion." The law excludes acts of war.

[31] Stephen J. Carroll, et al. 2005. *Distribution of Losses from Large Terrorist Attacks Under the Terrorism Risk Insurance Act* (Santa Monica, California: RAND Center for Terrorism Risk Management Policy).

although for the reason discussed already—terrorist attacks in one part of the country are an attack on the entire country—it is appropriate that taxpayers bear some of this risk (Nonetheless, the RAND study suggests that federal policy makers ought to consider whether to make the purchase or terrorism insurance by at least some commercial enterprises *mandatory*).

The federal government has adopted a more formal *primary* insurance program for one type of natural disaster—floods. Unlike terrorism reinsurance, flood insurance is paid for by traditional premiums *in advance*, which theoretically do not carry a subsidy. In addition, flood insurance is *mandatory*, at least for homeowners in flood pains who finance their property with loans obtained from federally chartered or insured financial institutions. In practice, however, the insurance requirement is not effectively enforced; while banks may be effective in requiring the purchase of the insurance at the time they extend a mortgage, there is no system to ensure that homeowners continue to carry the insurance thereafter. In addition, in practice, flood insurance premiums for many purchasers are subsidized: 26% of the policies are for structures that receive an explicit 60% discount off actuarially appropriate rates.[32] Furthermore, in the wake of Katrina, which put the entire program into deficit by perhaps $15 billion,[33]or more, it is likely that all flood insurance policyholders going forward will be subsidized to some extent by other policyholder or taxpayers, since it is unlikely that future premiums will fully reflect the elevated risks of hurricane-related floods in the future. Even with the subsidy and the purchase requirement, take-up rates for flood insurance eligible purchasers appear to be below 30 percent.[34]

Problems With De Facto Federal Insurance

Having established more formal insurance programs for terrorism and floods, the question naturally arises: is there anything wrong with the federal government continuing to provide *de facto* insurance coverage for large natural disasters—notably hurricanes and earthquakes—through existing disaster aid programs? The answer is "yes", for at least three reasons.

First, asking future taxpayers throughout the country to pay for disaster costs associated with specific, well-identified high risk areas—coasts along the Gulf and Florida clearly exposed to hurricanes, and California and perhaps a few other states exposed to earthquakes –is fundamentally *unfair* to citizens in who live in lower risk areas. Hurricanes and earthquakes are not like terrorist acts, where an impact felt by some is fundamentally an attack on all. These natural catastrophes are much more akin to floods, where the government already has clearly recognized the unfairness of asking citizens in areas not exposed to flood risks to subsidize those who choose to live and work in floodplains (although some subsidies occur because of the decision to discount some premiums from actuarially sound rates).

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[32] COFFI, 2005. p. 2.
[33] Ibid, p. 8.
[34] Ibid., p. 2.

Second, because the risks of hurricanes and earthquakes—even low probability, but high consequence "mega" events—can be actuarially estimated, it is *inefficient and more costly to society over the long run* to provide compensation after the fact rather than to charge those who live and work in higher risk areas *in advance* for the estimated annual damages associated with these natural disasters. This is because insurance premiums, when adjusted for risk exposure, can provide powerful incentives for policyholders to reduce their risk exposure, by purchasing or upgrading structures that are better insulated against disaster risks, and by applying political pressure on, or at least not opposing, state and local officials who adopt and enforce building codes and land use policies designed to reduce loss exposures in the event of future natural disasters. Indeed, the failure to provide monetary incentives through insurance actually encourages construction of structures that are in harm's way and thus invites future disaster aid—activities that already under way in Florida and the Gulf, as noted earlier. In short, as the Congressional Budget Office has concluded:

"Federal disaster assistance undoubtedly reduces financial hardships, but it may also discourage individuals and state and local governments from purchasing adequate insurance against future losses. *In effect, it subsidizes development in disaster-prone areas (ones for which insurers might be reluctant to provide coverage), and it weakens people's incentives to take actions that would reduce the cost of future natural disasters.*"(emphasis added).[35]

Third, except in the case of post-disaster aid for reconstructing and repairing public infrastructure, which typically covers a high proportion of the costs, after-the-fact disaster aid while providing some form of *de facto* insurance, does not compensate for losses as appropriately as would a typical insurance policy. Under a private insurance contract, payouts (and premiums) have more of a relationship to the pre-catastrophe steps insureds may take to minimize their losses.

Paying For Future Mega-Catastrophes: A Layered Approach

There is a better way. By converting *de facto* federal insurance for mega-catastrophes into a formal insurance program—without subsidies and with incentives for cost-effective mitigation—federal policy makers can rectify each of the flaws in the current system: its unfairness, its inefficiency, and its insufficient protection to potential victims.

Why focus only on mega-catastrophes? Because private insurance markets, including securities markets (with appropriate reform, as suggested below), can handle natural events below this threshold (to be defined shortly), albeit with some "timing risk" at the upper ranges of the risk retained by the private sector. But at some point, the timing risk becomes so substantial that actuarially appropriate premiums make private insurance (and catastrophe-linked bonds) too expensive for many individuals and firms to want to purchase. This is not simply a matter of fairness, but also efficiency, because when private insurance markets do not work and the federal government steps in after

[35] CBO, 2002, p.17.

the fact—as it inevitably does—then the flaws just described in *de facto* insurance become evident and relevant.

The broad approach for financing future mega-catastrophes suggested here is a "layered" one where individuals, insurers, reinsurers, securities markets, and state catastrophe insurance and reinsurance funds—in that order—bear the costs up to some threshold, after which the federal government steps in, through reinsurance provided at actuarially appropriate premiums that take into account state and local efforts to mitigate losses (See Figure 1). To some extent this approach has been taken with terrorism risks, though no terrorism-related securities currently are on the market; no premiums are charged in advance by the federal government in its role as a reinsurer; and thus monetary incentives from the federal government do not exist to encourage mitigation.

It bears emphasis that even with a federal reinsurance program for the risks to privately owned property, federal disaster aid still is appropriate and necessary to assist local and state governments in responding to disasters and in reconstruction of public infrastructure. However, to the extent that a reinsurance program enhances the take-up rate for private insurance, it will relieve the federal government of the need to provide some disaster aid, while also encouraging private and public sector efforts to implement and enforce appropriate building codes and land use policies that reduce the total costs of future catastrophes (for individuals and their governments alike).

Policyholders Should Bear The "First Loss", With Limits

Virtually all insurance policies contain "deductibles," or amounts that the policyholder must bear before the insurer pays any claim, which are present to minimize moral hazard. At the same time, insurance markets can fail if, because of the nature of the risk, insurers can only provide insurance with appropriately high deductibles, even as much as the first 5% of loss. In that event, insurance take-up rates are likely to be low, and even then, those who do buy policies may be those especially prone to risk, subjecting the insurance pool to adverse selection. This appears to be the present state of affairs in California, where as noted, coverage provided by the CEA carries a large deductible and the take-up rate, not surprisingly, is very low.

Private Insurance and Securities Markets

Primary insurers, reinsurers and catastrophe linked securities should pay for the next layer of losses associated with mega-catastrophes. This "layer" in fact can and should be quite large, up to the trigger point at which federal reinsurance would kick in (to be discussed shortly).

As discussed earlier, one reason for the disappointingly slow development of the catastrophe-linked bond market in particular is that state insurance regulators have not allowed insurers issuing non-indemnity catastrophe-linked bonds in particular to claim any reinsurance treatment or credit for these securities. This is because any bond whose

non-payment is triggered by anything other than insurer-based claims losses by definition has some "basis risk", and is technically not reinsurance.

But this all or nothing" approach to the treatment of these securities is ill-advised. Even bonds with some basis risk can afford insurers some protection. Accordingly, insurance regulators should assign these securities some partial reinsurance credit, depending on the likelihood that any index or event definition would trigger non-payment of the bond principal. Bonds with triggers with lower basis risk than others should receive a greater degree of proportional reinsurance credit.

Clearly, there are actuarial and measurement issues here that must be resolved before regulatory and financial accounting for such securities is changed. The National Association of Insurance Commissioners (NAIC), the body representing all state insurance regulators, should act on their behalf by establishing a working group or commission to develop appropriate methods for assigning partial reinsurance credit for non-indemnity catastrophe bonds. Assuming those methods are accepted by insurance regulators, the NAIC should urge the Financial Accounting Standards Board, which sets financial reporting standards for all publicly-held companies, to adopt them as well for financial reporting purposes. Once these events occur, then insurers would have greater incentives to issue the bonds, especially if the obligation to repay the principal is more likely to be cancelled than is the case now with catastrophe-linked bonds that are now on the market.

Policy makers should not assume, however, that merely because insurers would be more likely to issue the bonds that investors would snap them up at current, or ideally lower, interest rate premiums than these bonds now command. As discussed earlier, securities that are more likely to have their principal repayment obligation cancelled also carry more risk for investors, who naturally would respond by demanding *higher* interest rates. Given the present state of the catastrophe bond market, it is not possible *a priori* to predict whether, at the end of the day, insurers still would issue more bonds at higher interest rates, but with the more liberal accounting treatment. Regulatory reform, in other words, should not be viewed as a "silver bullet" that will enable the securities markets to solve the catastrophe insurability problem. Moreover, rate suppression that disallows the full cost of such bonds as a component of insurer expenses can further compound the problem.

One important public policy issue is whether catastrophe coverage—hurricanes for coastal areas and earthquakes for California—ought to be mandatory. As the flood insurance program shows, however, it is virtually impossible to enforce the purchase requirement after lending institutions have provided homeowners with the mortgage they need. In addition, in the case of catastrophe coverage, a further difficulty is defining exactly what kind of policy ought to be required (including the specific events, deductibles, and so forth). Furthermore, the catastrophe insurance market has not yet benefited from having a federal backstop insurer, which should bring greater rationality to premiums. In light of the other practical difficulties with any mandate, the suggestion here is that policy makers therefore wait to see what happens to take-up rates following

the implementation of an appropriate government reinsurance plan before considering any mandate.

State Catastrophe Funds

State catastrophe funds, whether for primary coverage or reinsurance, can and should play an important role in any overall natural catastrophe financing system. The local nature of these funds also provides states with greater incentives to engage in better land-use planning and mitigation. Yet, as noted earlier, as these funds alone were not set up to deal with mega-catastrophe risk, nor can they be realistically expected to do so, given the timing and uncertainty risks that mega-catastrophes entail. As a result both the California and Florida plans cap the coverage they provide. A federal backstop program, like the one outlined below, solves the timing and uncertainty risk problems that the state plans (and private insurers) inevitably face.

Federal Reinsurance

Given the timing risk inherent in mega-catastrophe risks, coupled with the uncertainties surrounding the willingness of insurers to issue and investors to buy catastrophe-linked securities, the federal government—and thus ultimately taxpayers—remains the insurer of last resort for such events. The proposal here is formalize this reality by establishing a National Catastrophe Insurance Program (NCIP) to provide reinsurance to primary insurers and/or state plans offering catastrophe coverage.

Like its terrorism counterpart, the NCIP could be administered directly by an office within the Treasury Department. However, because the program suggested entails more duties, it would enhance the office's independence under either reinsurance system recommended here if the office had separate agency status, but formally belonging to the Treasury Department (much as the Comptroller of the Currency, the regulator of national banks, does now). The more independent is the office, the more insulated it is likely to be against political pressures to provide the reinsurance at subsidized rates, as has happened with the federal flood insurance program and, to varying degrees, with some state catastrophe funds. Furthermore, if such an agency were established, it could make sense to place with it the terrorism risk insurance program (assumed it is reauthorized) and the federal flood insurance program, which is currently administered by the Federal Insurance Administration **(**currently a part of the Federal Emergency Management Agency (FEMA), which in turn is part of the Department of Homeland security).[36]

Attachment Point: Perhaps the most important design issue for any reinsurance program is the nature of the trigger that invokes federal insurance. In the case of the terrorism program, the trigger is a combination of an event—a "terrorist" act as certified by the Secretary of the Treasury—coupled with an insurer-specific dollar amount as an

[36] Many of the issues discussed here in connection with reinsurance for natural disasters arise with respect to terrorism risk insurance. For a guide to this topic, see Howard Kunreuther and Erwann Michel-Kerjan, 2004. "Challenges for Terrorism Risk Insurance in the United States," *Journal of Economic Perspectives*, Vol. 18, No. 4, Fall, pp. 201-14.

attachment point, or equivalently, a deductible (amounts in excess of 15 percent of the earned premium from TRIA-eligible insurance, or commercial lines). The deduction applies to individual acts of terrorism, as well as the cumulative losses due to multiple terrorist attacks during the course of a calendar year. The advantage to the primary insurers, and thus to their policyholders, of an insurer-specific attachment point is that it eliminates basis risk and thus makes the program true reinsurance. Moral hazard is avoided by requiring the insurer to bear 10 percent of the loss above the attachment point.

The event-dollar magnitude approach of TRIA can be readily applied, at least in principle, to mega-catastrophe risk reinsurance. The eligible "events" could include hurricanes (perhaps above a certain defined level, such as at least a Category 2 or 3), and earthquakes (perhaps above a certain Richter-scale magnitude, which could vary by geographic region, since a lower magnitude earthquake along the New Madrid could impose just as much or even more damage than a California earthquake 10 or more times as powerful). Alternatively, the legislation could define eligible events to include catastrophes below a certain probability, such as one in fifty or one in a hundred, on a state-specific basis, and let independent actuaries retained by the federal reinsurance agency define the level of damage associated with that probability threshold.[37]

With respect to the dollar thresholds, or equivalently deductibles, there are a number of approaches to setting the attachment point. Perhaps the simplest is to have the federal insurance kick in only once cumulative insured losses from eligible "events" in any calendar year cross the dollar threshold associated with the given probability. For example, this might mean that federal insurance for Florida hurricanes requires the private sector and the state plan to bear, say, the first $15 billion in losses; the federal program would pay 90 percent of the losses above that amount.

An alternative approach is to define the deductible on an insurer-specific basis, as under TRIA: for example, as a percentage of the particular insurer's premium. The choice of a specific percentage figure for the attachment point inherently will be somewhat arbitrary. In principle, it should not be so low as to preempt private or state-sponsored reinsurers, or the development of a viable catastrophe securities market; at the same time, it should not be so high as to render the reinsurance without much value to primary insurers, and thus to their policyholders (still leaving the federal government with the residual risk in the form of disaster assistance).

One way to think about an appropriate insurer-specific deductible is to compare losses to the total property premiums collected by primary insurers. As shown in Table 3, 2004 premiums for total homeowners' and commercial multi-peril peril lines totaled approximately $80 billion. Meanwhile, Table 1 illustrates that the current insured cost of Hurricane Andrew, the second most expensive natural disaster in American history, was

[37] There are a number of nationally recognized firms that, among other things, develop these probabilities. The government agency could look to these firms, and any qualified new entrants, and take an average of their projections (much as the Congressional Budget Office now does with budget projections, taking into account an average of multiple private sector forecasts of GDP in setting its own GDP forecast).

$21 billion, or roughly 25 percent of current property insurance premiums.[38] Andrew is important because thereafter several of the nation's largest insurers attempted to withdraw from the Florida property market—but were prevented by the state legislature from doing so. Nonetheless, the fact that the withdrawal was attempted or at least openly discussed is evidence that losses of magnitude of an Andrew, let alone a Katrina, are deemed too high for primary insurers to bear, even though they may have access to reinsurance. In addition, Andrew is a useful reference point because eleven insurers were declared insolvent following the storm.

For this reason, one possibility is that an insurer-specific attachment point (if this approach were taken) be something like 20 percent of prior years' earned premiums in eligible lines (residential and commercial multi-peril), a figure modestly below the level implied by the foregoing calculation, but above the 15 percent level applicable to terrorism risk insurance.

In any event, the federal insurance agency should have the freedom to sell policies with different deductibles (either state or region wide, or insurer-specific, and at different levels), and to charge appropriate premiums accordingly.

Premiums and Recoupment: The proposed program would differ from TRIA in more fundamental ways. For one thing, given that it is possible for actuaries to make at least some estimates (imperfect as they may be) of catastrophe risks, it is appropriate that the federal government charge premiums *in advance* for the reinsurance. In addition, the premiums should be set specifically to encourage mitigation by state and local governments, by appropriate and well-enforced building codes, and by sensible land use planning. It is not recommended that the federal government override state and local decisions in these arenas, which historically and most likely constitutionally lie solely within the province of state and local governments. But since state and local building code and land use rules and enforcement have clear effects on the amounts of federal disaster aid, and on the insured losses under any federal reinsurance program, it is only appropriate—indeed, it is necessary—for the federal government to take account of such measures in setting premiums, or even in establishing eligibility for reinsurance.

This will not be easy to do. The federal agency that implements the program will require experts capable of reviewing state and local building codes and zoning rules for adequacy, for monitoring (most likely through spot checking) how these rules actually are enforced, and for translating both the rules and the degrees to which they are enforced into credits or reductions of reinsurance premiums.

Nor will it be easy to set premiums in a way that is fully insulated from the kinds of political pressure that has affected rate setting in the federal flood insurance program and in the state-sponsored catastrophe funds. Ideally, it would be desirable if the reinsurance offered by the federal government could be auctioned off to primary insurers

[38] This calculation and the attachment point recommended below ignore automobile damage claims. While these losses can be significant, they are unlikely to exceed several billion dollars, and thus pale in comparison to the potential property damage caused by natural catastrophes.

(and to speculators as well, who would add liquidity to the market), since that would enable the market to set the price of the reinsurance, though the federal reinsurance agency probably still would be required to make some adjustment to that price to provide the mitigation incentives just outlined. In fact, an auction mechanism for such reinsurance contracts was at the heart of a number of catastrophe reinsurance proposals considered by the Clinton Administration and the Congress during the 1990s. These "excess of loss" (or XOL) contracts would pay off to their holders in the event *aggregate* or *industry-wide* catastrophe losses from a single event or over a calendar year (depending on the proposal) exceeded a certain attachment point, but only up to some ceiling. The XOL contracts could come in various forms, as national contracts (where a $25 billion attachment point was considered, along with a $50 billion ceiling), or regional or state-specific contracts (with correspondingly lower attachment points and ceilings).

Proposals involving the sale of XOLs were not adopted, in part because of administrative questions or issues surrounding the contracts. If tied to specific events, how quickly would the contracts pay out, especially since it takes time after a disaster to know the amount of insured losses, not just for individual insurers, but especially for the entire industry? There was also uncertainty about how "thick" the market for various XOL contracts would be, and thus how well "the market" would actually price the contracts. This uncertainty stemmed in part from the basis risk inherent in the contracts, just as it is inherent in non-indemnity catastrophe-linked bonds. Since individual insurers (and the various state plans) could not know in advance whether their losses would be covered by any contract—until the industry-wide loss figures came in—it was not clear how much interest insurers would have in buying (or selling) them.

The proposal suggested here takes a different approach, one modeled on TRIA, in that it establishes a federal backstop but is more comprehensive and efficient in its operation. In particular, the federal program envisioned here explicitly would sell *reinsurance,* and thus would reimburse specific insurers on losses exceeding a specified deductible. This eliminates basis risk. But auctions are not feasible for reinsurance, since the value of the reinsurance is known and of value only to specific insurers. Accordingly, some one or some body must set the premium. And unlike a competitive market in reinsurance, where buyers have choice among multiple providers and thus are able to negotiate, a federal program by definition would have a monopoly.

Thus the challenge arises: how to set premiums that are actuarially appropriate, taking into account the loss mitigation incentives that also must be built into the premium-setting process, as well as the appropriate "risk load" to apply to the estimates? As discussed earlier, the risk load is the multiple that is applied to the annual expected loss to reflect timing risk and general uncertainty surrounding the loss estimate itself. In private markets, the risk load is typically 5 to 7 times (400 to 600 percent) expected loss. This level is clearly too high, for it is the main reason why individuals choose not to purchase private insurance. On the other hand, the CBO has reported, in the context of prior XOL proposals, that a risk load of two to three times expected loss (100 to 200

percent) is too low to protect taxpayers.[39] The CBO also concluded that those prior proposals probably would be costly to taxpayers, though it admitted the budgetary impact, including any offsetting impacts of lower amounts of disaster aid, was uncertain.[40]

The proposals the CBO were costing out, however, did not have the incentives for mitigation nor the insurer co-pays that are built into the proposal suggested here, and thus a risk load of 100-200 percent may be appropriate, if not unduly generous. More important, unlike the XOL proposals, the current proposal would require the federal reinsurance agency to impose post-event assessments to recoup all federal payouts (not subject to a ceiling amount, as under TRIA), although the agency should have discretion to decide the period of recoupment (subject perhaps to a ceiling, such as 20 years).

As a result, the proposal advanced here would not subsidize catastrophe insurance, but instead substantially remove the timing risk problem that currently can make it too expensive or coverage too limited for consumers to want to buy it. Furthermore, the practical difficulties of setting appropriate premiums that reflect mitigation efforts at the state and local level should not be overstated. Nor should they be showstoppers to the adoption of a federal program. *Policy makers should not let the perfect be the enemy of the good. Even an imperfect premium structure for federal catastrophe reinsurance, coupled with a recoupment system to correct for "mistakes" and catastrophes that strike "too early" (or before sufficient insurance premiums have been collected to pay for future catastrophe costs) would be far superior to the current system of de facto insurance that imposes no charge at all on those who choose to expose themselves to catastrophe risk.*

One possible supplement to the proposed program could be a feature that encourages those states that now operate state plans not to force them to subsidize insurance rates. A way to do this would be to permit the federal reinsurance agency to award some defined credit against reinsurance premiums for private and state-sponsored insurers in states that operate their catastrophe insurance plans "substantially in accord with actuarial principles" or which set their premiums "substantially based on risk." The availability of such credits at least would offset some of the political pressure on the administrators of those plans to set premiums at subsidized levels. Indeed, coupled with the lower insurance rates that federal reinsurance should make possible (especially if state and local mitigation measures are adopted and enforced), such credits might allow premiums to be set at or below current levels.

Finally, any legislation creating a federal reinsurance fund should contain language ensuring that the premiums collected are deposited in a separate account, which cannot be used to support other federal spending (although the federal reinsurance

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[39] Congressional Budget Office, *Cost Estimate for H.R. 21, Homeowners' Availability Act of 1999* (February 9, 2000); *Cost Estimate for H.R. 219, Homeowners' Availability Act of 1998* (September 23, 1998); and *Cost Estimate for H.R. 230, Natural Disaster Protection and Insurance Act of 1997* (October 8, 1997).

[40] CBO, 2002, p. 24.

agency would be directed to invest the proceeds in Treasury securities, which are the lowest risk instruments. In addition, the agency should be directed to accept only a modest degree of interest rate risk, and thus to invest in securities with maturities no longer than a given number of years).

Conclusion

Often it takes a major event to set the stage for policy action. Congress reformed the nation's laws governing depository institutions after several thousand of them failed during the 1980s, costing taxpayers roughly $150 billion (and the depository industry itself tens of billions more, in the form of deposit insurance premiums). After 9/11, Congress quickly acted to restore health to the commercial insurance market by establishing a federal terrorism risk reinsurance program.

In 2005, nature has intervened, generating the worst year of catastrophe damage on record. Though much of this cost will be paid by insurers, most of it—especially that associated with Katrina—will not. Citizens in need, and their political leaders, have looked to the federal government to ease the financial pain of the victims and to pay for the expensive reconstruction of the devastated areas.

This outcome is natural and understandable, but it is also inefficient and unfair to ask taxpayers generally to pay for the expected costs of future disasters, rather than to impose such costs in advance, on an actuarial basis, on those that choose to be most exposed to these risks. At the same time, it is also inefficient and unfair to ask those at risk to pay for insurance that is more expensive than it needs to be or too limited in coverage.

Here is where the federal government can help in a constructive way. Because only the federal government can afford to pay claims arising out of large catastrophes before sufficient premiums have been collected to finance them, it does not have the "timing risk" that inevitably confronts private insurers, reinsurers, and investors in catastrophe-linked securities. Accordingly, at some level of exposure, the federal government can and should formalize its post-catastrophe aid to victims by establishing a reinsurance program for catastrophe risks.

The reinsurance proposal outlined here borrows some features from a similar program already present for terrorism risks, but also differs in key respects from the terrorism reinsurance program: it is largely pre-funded, and any post-event assessments are not limited so that no subsidy to policyholders living in exposes areas are involved. In addition, the proposal contains incentives for individuals, state and localities to take action to prevent or minimize future catastrophe losses.

We may not be able to control nature, but we can and should take measures to minimize the damage it can sometimes cause. The proposal suggested here does that, and more—by providing risk-based insurance against catastrophe risks with incentives for loss mitigation. If there is a silver lining to the horrible 2005 hurricane season, it is that

these tragic events may create a unique window and political environment for policy makers to address a problem that has long needed attention.

Appendix A

Government Catastrophe Insurance in Other Countries

Other countries have established formal government insurance or reinsurance programs for catastrophes, both natural and man-made (terrorism).

A number of countries use tax revenues to pre-fund natural disaster relief accounts: Australia, Denmark, Mexico, the Netherlands, Norway and Poland.[41] Others have established formal government plans. Spain has plan for "extraordinary risks" (natural disasters and terrorism), which is mandatory and included as an add-on in private property insurance policies. France requires catastrophe coverage in all private non-life policies, whose underwriters can reinsure with a state-guaranteed reinsurer. The French government sets the premium surcharge for the reinsurance. Japan has a similar reinsurance program for natural hazards (earthquakes and tsunamis).

Eight OECD countries have formal terrorism insurance programs, all established after 9/11, except for the programs in Spain and the United Kingdom (where terrorism had occurred before previously).[42] The plans vary in coverage layers and amounts, whether a premium is charged in advance, and whether the coverage is temporary or permanent.

[41] Paul K. Freeman and Kathryn Scott, 2005. "Comparative Analysis of Large Scale Catastrophe Compensation Schemes," in *Catastrophe Risks and Insurance* (Paris: Organization for Economic Cooperation and Development).
[42] For an extensive description, see OECD, 2005. *Terrorism Risk Insurance in OECD Countries* (Paris: Organization for Economic Cooperation and Development).

Figure 1

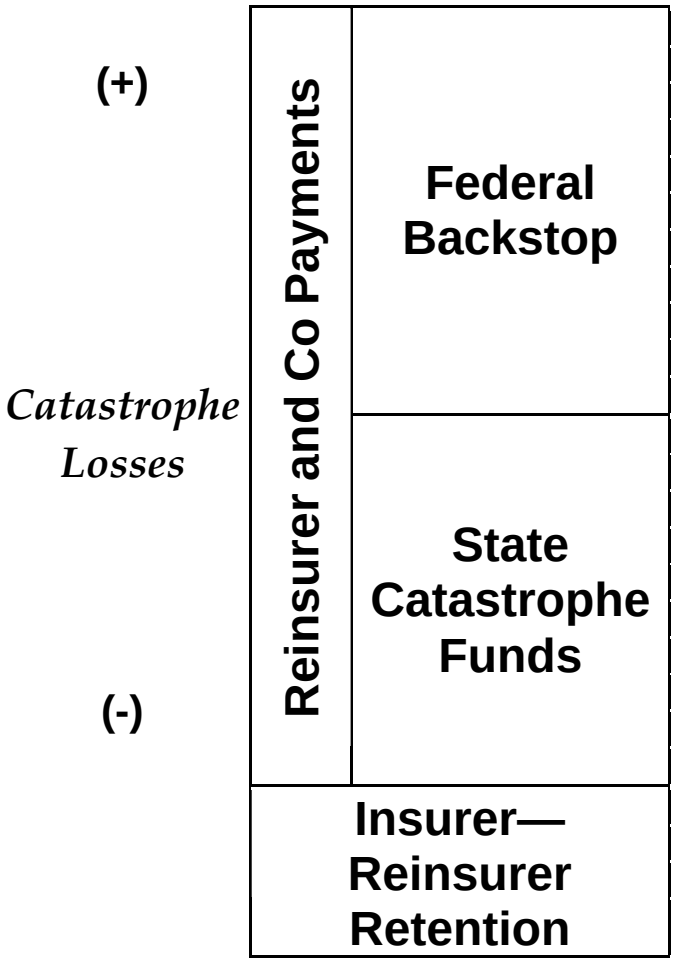
(+)
Catastrophe Losses
(-)
Reinsurer and Co Payments
Federal Backstop
State Catastrophe Funds
Insurer—Reinsurer Retention
Share of Losses

Table 1

Twelve Costliest Insured Catastrophes in the United States

Costs in Billions of 2005 Dollars

Year	Event	Cost
2005	Hurricane Katrina	40+
1992	Hurricane Andrew	21
2001	9/11 Terrorist Attacks	20
1994	Northridge Earthquake	16
2004	Hurricane Charley	8
2005	Hurricane Wilma	4-10
2004	Hurricane Ivan	7
1989	Hurricane Hugo	6
2004	Hurricane Frances	5
2004	Hurricane Jeanne	4
2005	Hurricane Rita	3-6
1998	Hurricane Georges	3

Source: Insurance Information Institute; RMS, AIR Worldwide, and Eqecat for Wilma and Rita

Table 2

Potential Current Property Losses Due To Various Possible "Mega-Catastrophes"

Event	Loss (Billions of 2005 dollars)
Hurricanes:	
Category 5 in Houston	40
Category 5 in Tampa	65
Category 5 in Miami	155
Category 5 in New York area (including New Jersey And Long Island)	96
Earthquakes:	
7+ in Los Angeles	140
8+ in San Francisco	200
7.5+ New Madrid (St Louis/Memphis and other Areas)	90

Notes: Losses are for both residential and commercial properties, but only those on-shore (the loss estimates do not include covered losses to offshore energy facilities and other marine exposures). Insured losses as a fraction of total losses are likely to be much less for earthquakes due to low take-up rates for earthquake insurance.

Source: AIR-Worldwide (supplied to the author)

Table 3

Property-Casualty Insurance Industry
Key Statistics
2004

Line of Business	Net Premiums Written (Billions)
Total P-C Industry	436
Private Passenger Auto Liability	93
Automobile Physical Damage	72
Homeowners' Multi-Peril	49
Worker's Compensation	46
Other Liability	40
Commercial Multi-Peril	29
Commercial Auto Liability	19
Reinsurance	9
Medical Malpractice	9
Fire	8
All Other	61

Source: A.M. Best, *Best's Aggregates & Averages*, 2005, p. 98

Table 4
Insured Catastrophe Losses, By Year
(Billions of Dollars of that Current Year)

1992	22.9
1993	5.5
1994	16.9
1995	8.3
1996	7.4
1997	2.6
1998	10.1
1999	8.3
2000	4.6
2001	26.5
2002	5.9
2003	12.9
2004	27.5
2005	50+

Source: Insurance Information Institute; Estimate for 2005 includes 39.9 estimated through Katrina, plus some additional allowance for Hurricanes Rita and Wilma, and additional insured claims associated with Katrina

Table 5
U.S. Federal Disaster Aid
(Billions of 2005 dollars)

Year	Event	Amount (Billions)
2005	Hurricane Katrina	62 (likely to top 100)
2001	9/11 Terrorist attacks	20
1994	Northridge Earthquake	15.5
2004	Florida Hurricanes	14
1992	Hurricane Andrew	10.8
1989	Loma Prieta Earthquake	7.6
1993	Midwest Floods	7.0
1989	Hurricane Hugo	3.1

Source: Insurance Information Institute

Table 6

Federal Disaster Aid Programs for Individuals, Households and Small Businesses

Agency	Type/Amount of Aid
FEMA	Cash grants of up to $26,000 for temporary housing and Other needs (such as medical and transportation costs)
SBA	Low interest loans to cover expenses of individuals, farmers, and small businesses, not covered by state or local programs or private insurance; individuals who do not qualify for loans may get cash assistance
VA	Adjustment to mortgages for veterans
IRS	Casualty loss deductions
Labor	Disaster unemployment benefits